

the spontaneous separation of the enclosed portion of the cotyledon, the testa is frequently found ruptured, but Mr. Griffith does not concur with Roxburgh in regarding this as the stage of germination, which he thinks cannot be said to take place until the radicle has elongated and the innermost of the plumular processes become expanded. The axis contains the rudiments of additional radicles, which after germination become exerted.

Mr. Griffith thinks that the whole of the anomalies existing in the structure of the embryo may be referred to the density of the texture of the nucleus and to the shape of its cavity. The direction of the radicle appears at first sight to be an exception to a very general rule; but this anomaly is proved to take place subsequently to the earlier stages of development, during which the apex of the radicle corresponds exactly with the apex of the nucleus and with the foramen. He adds in a note that he would limit the expression of the law to "radicle pointing or corresponding to the apex of the nucleus," since there are exceptions to its correspondence with the foramen.

The perforation of the testa by the radicle is explained by the anomalous direction of the radicle in the later period of its development; and the separation of the chief part of the cotyledon by the constriction exercised upon it by the indurated apex of the nucleus. Mr. Griffith is inclined to believe from this and some other instances that there is no *absolute* necessity for a cotyledon, but that its presence may be supplied by a highly developed plumula; the enormous development of the plumula in the present case being evidently adapted to correct what would otherwise be a destructive anomaly.

Finally, the author adduces the examination of this plant as a striking proof of the advantages to be derived from tracing anomalous forms back to the earliest period of their development. Going back to the period immediately before the conical apex of the radicle projects through that of the nucleus, we arrive at a stage when the form of the embryo closely resembles the usual form of the *Aroidea*, since we have a superior radicle, a cotyledon, and a tendency to the formation of a lateral slit, as indicated by the depressed areola.

BOTANICAL SOCIETY OF EDINBURGH.

Feb. 12, 1846.—Dr. Balfour, President, in the Chair.

A large collection of plants from Chippawa, Niagara, and various parts of Canada, was presented from Dr. Philip W. Maclagan; and specimens of some of the rarer alpine plants of Scotland by Dr. Balfour.

The following communications were read:—

1. "On the Potato Disease," by John Goodsir, F.R.S.E., Demonstrator of Anatomy in the University of Edinburgh, and Secretary of the Botanical Society.

In reference to the nature of the potato disease, Mr. Goodsir stated that there could be no doubt as to its general resemblance to an epi-

demic. Although we may not have discovered the causes of epidemic diseases, we know they depend partly on local or individual circumstances which may be obviated, and which influence some epidemics more than others; and partly to general influences, commonly supposed to be atmospheric, but regarding which we actually know nothing but their existence. Mr. Goodsir then alluded to the striking general resemblance between the rise and progress of epidemics, and the appearance, non-appearance, and increase of fungi from season to season. Coupling this analogy with the opinion generally gaining ground, that certain epidemics owe their existence to the growth of fungi or analogous beings in the animals afflicted, Mr. Goodsir conceived that we are bound, in our attempts to explain the nature of the potato disease, not to overlook the fungi which exist in the diseased tubers. After stating Mr. Berkeley's late researches into the fungoid nature of the disease, Mr. Goodsir observed, that he was still inclined to believe in the organic nature of the brown matter; and he founded his belief chiefly on its peculiar form, and on its position in the cells. This view of the nature of the potato disease did not afford an indication of cure or prevention, for the diseases with the nature of which we are best acquainted are not always those we can most certainly cure. It holds out, however, a hope that the murrain may not recur. The occurrence of fungi as the cause of disease was pointed out in various instances, especially diseases of the skin where mycodermatous fungi are seen, diseases of the mucous membrane, and diseases of the stomach. The occurrence of cellular plants (*Torula cerevisiæ*) during fermentation was also alluded to as corroborative of Mr. Goodsir's views. The paper was illustrated by large drawings of the diseased structure of the potato, of the brown granules, and of *Botrytis infestans*, &c.

Dr. Greville in making a few observations, commenced by paying a high compliment to the talents of Mr. Goodsir, and the general accuracy of his microscopical researches. "With reference to that gentleman's theory," said Dr. Greville, "I see nothing improbable in the potato murrain being analogous to epidemic diseases in the animal kingdom. In fact the analogies between the two great kingdoms of organized matter are so many and so strong, that he might reasonably look for much similarity among some of the phenomena exhibited in both, with regard to disease. Like epidemics in the animal world, the one under consideration has appeared almost simultaneously in various and remote parts of the globe; a fact which seems to indicate some atmospheric influence. The real cause, as in the case of all epidemics, is involved in the greatest mystery. Possibly a union of conditions may have taken place favourable to the development of the fungus which appears to be invariably present. We all know that in the germination of monocotyledonous and dicotyledonous seeds a union of three conditions is essential,—the presence of air, warmth, and moisture. If any one of these conditions be wanting, the seed will not germinate, but, if otherwise favourably circumstanced, will remain in a dormant state for an indefinite period. In like manner I think it not improbable that certain con-

ditions—one or more of them being of a meteorological character—may have combined in the course of the past season to promote the growth of the potato fungus. The question has been asked, how do the spores of the fungus obtain access to the vegetable tissue? This at present is a matter of mere speculation. They are excessively minute; and it has occurred to me that they, as well as the spores of other of the minute fungi, may at all times inhabit the tissue of those species of plants to which they are respectively peculiar without, under ordinary circumstances, deranging the vegetable functions, in the same manner as minute parasites infest different parts of the animal structure. In addition to this, there must be in plants as well as in animals a *predisposition* to receive the disease; for even epidemics make a selection of their victims. The fungus did not attack all plants of the potato indiscriminately; some varieties throughout the infected districts having, comparatively speaking, escaped,—a most valuable fact for the consideration of the practical agriculturist. With reference to the brown granules, which Mr. Goodsir believes to be organic, I confess I have been quite unable to satisfy myself regarding their nature. Their form is not constant, and under the microscope I sometimes find it impossible to distinguish them from the grains of starch. I cannot, besides, detect any determinate arrangement of the granules, which the microscopical observer would naturally expect to exist in a series of more or less spherical organic bodies. Certainly, the brown spots in the tuber require more investigation than they (so far as I know) have received. My attention was directed to the potato disease late in the season, and no opportunity was afforded me of examining the leaves or the stalks. It has struck me, however, in reading Mr. Berkeley's valuable memoir, that the black spots on the stalk, where the cellular tissue is described as filled with a dark grumose mass, may correspond with the brown spots in the tuber, the cells of which contain the brown grumose granules, and that the one may throw some light on the other."

Mr. Walter Crum of Glasgow detailed his experiments on the brown colouring matter in diseased potatoes, and stated that it contained nitrogen. He had carefully examined the brown granules alluded to by Mr. Goodsir, but did not believe it was a fungus.

Dr. George Wilson was much interested in what Mr. Goodsir had said in reference to the connexion between the disease in the potato and the appearance of a fungus, and in the comparison which he had drawn between it and a solution of sugar undergoing the vinous fermentation in which a cryptogamic plant always showed itself. Dr. Wilson was of opinion, however, that the vegetable physiologist was not entitled to refer to the fungus as the *cause* of fermentation, or to speak of it as more than an accompaniment. On the other hand, he was free to acknowledge, that as the chemist could not point to a single example of the vinous fermentation having been observed without the *Saccharomyces* being seen also, he was not at liberty to explain the fermentation without reference to the fungus as he generally did. Dr. Wilson believed that fermentation was at present

an Oregon territory in science, which the chemist and physiologist must in the meanwhile agree to hold in joint occupancy till it could be settled which had the best right to it, or on what terms it should be divided. Mr. Goodsir had not done himself the justice to mention, that in a remarkable case of disease in the human subject, in which the contents of the stomach underwent a change exceedingly like that which vegetable juices suffer when the lactic or viscous fermentation is going on within them, he predicted the great likelihood of a cryptogamic plant being found, and discovered a very curious one, the *Sarcinula ventriculi*. Dr. Wilson would suggest to microscopic observers, that it was possible each of the true fermentations might have a fungus peculiar to itself, and that it was well worth their attention to investigate the subject. Sugar could be fermented into alcohol and carbonic acid, into lactic acid, or into mannite and mucilage. It was desirable to know if a new fungus appeared when the fermentation changed its character. Dr. Wilson anticipated that no cryptogamic plant would be found when diluted alcohol was converted into acetic acid by platina black, because no azotized compound was present to yield nitrogen to the fungus, without which, in all probability, it could not be developed. The acetous fermentation, however, differed in several important particulars from the others referred to.

Dr. Douglas Maclagan entertained no doubt, from the observations of Mr. Goodsir, Mr. Berkeley, and others, that the fungus present in the diseased potato had originated in the leaves, and been propagated down along the stem to the tubers. He had himself observed, and rudely sketched, an organism in the diseased tubers, which, from the drawings exhibited this evening, he had no doubt was identical with that observed by Mr. Berkeley growing from the stomata of the leaves. There was also, he thought, little doubt as to the nature of the brown matter which pervaded the diseased portions. Although it had not been demonstrated microscopically to be a fungus, the fact of its having been separated by M. Payen, by maceration, and subsequent boiling with diluted sulphuric acid, and its being ascertained to contain a proportion of nitrogen equal to that found in analogous parasitical vegetable organisms, appeared to warrant the conclusion that it really was of the nature of a fungus. He thought, however, that the question as to the nature of the potato disease was not settled by proving the presence of a fungus in the altered portions. It was still a disputable point, whether the fungus was antecedent to, or consequent upon, the morbid state of the tubers; it was yet doubtful, whether the discrimination of the first advances towards the disease fell within the province of the chemist or the botanist. He had frequently observed, on making sections of affected potatoes, portions in the interior of the tubers in which no discoloration had commenced, but which were in a softened pulpy condition. A portion of this could at once be lifted out on the point of a knife, and on being subjected to microscopic examination, no fungus, or brown granular matter could be observed; but the amyliiferous cells of the tuber, and these contained starch grains, were found in a swollen

state, as if they had been filled with fluid by endosmose, and the compartments of the cellular tissue had thus become so entirely detached from each other, as to have assumed a complete round form, instead of their characteristic hexagonal shape. It appeared to him to resemble what might be expected from the maceration of the textures in water, and it was a possible supposition that this might be the first stage of the disease, and that the change thus effected in the tuber formed a nidus fitted for the development and growth of the fungus already existing in the aërial parts of the plant.

Mr. Milne being invited by the President to give his opinion, stated the gratification with which he had listened to the statements made by Mr. Goodsir and other speakers. Nothing could be more distinct than the description given of the nature of the fungus which appeared to accompany the disease, and the parts of the potato affected by it. The discussion, however, had been confined entirely to a description of the fungus, and to speculations on its probable effect in altering the condition of the potato. No one had as yet offered any opinion as to the circumstances which led to the production of the fungus. If it arose from seeds dormant in the potato, what was it which had caused them to germinate? If it arose from seed or matter in the atmosphere, was there anything in the state of the atmosphere to account for it in one part of the globe and not in another? He had been devoting attention to the meteorological branch of the inquiry, and he thought that he had made a discovery, which would explain the appearance of the disease in some places and not in others. But he had not come prepared to enter into particulars, not supposing that any persons, unless they were members of this Society, could take part in the proceedings; he would therefore indicate generally the results. Mr. Milne then described some peculiarities of the weather in England and Scotland during the summer and autumn of last year, as shown by meteorological returns which he had obtained from a number of places, both in those districts where the disease prevailed, and in those from which it had been absent. He mentioned that the maximum summer heat had occurred in England and the southern parts of Scotland in June, whereas in the northern parts of Scotland, where the potato disease had not appeared, the maximum heat had occurred in August as usual. He alluded also to repeated and sudden thermometric changes which had occurred in the south of England.

Mr. Brand and Mr. Girdwood remarked, that potatoes in the early part of the season were not affected, and that where the stems and leaves had been cut away early, the disease had not appeared in the tubers left in the ground. These facts seem to indicate some atmospheric influences which had come into operation late in the season, or some cause which did not take effect till the tubers were fully developed.

2. "A Synopsis of the British Species of the genus *Rubus*," by Charles C. Babington, M.A., F.L.S. &c. (This paper is in the course of publication in these Annals.)

March 12, 1846.—Dr. Balfour, President, in the Chair.

Various donations to the library and museum were announced, and thanks voted to the respective donors.

The following communications were read:—

1. "On the altitudinal range of the Mosses in Aberdeenshire," by George Dickie, M.D., Lecturer on Botany in the University and King's College of Aberdeen. (This paper will be published in these Annals and in the Society's Transactions.)

2. "Remarks on the state of the Sibthorpean Herbarium at Oxford, suggested by the announcement of a new edition of the 'Flora Græca,'" by Dr. R. C. Alexander.

3. "Botanical Excursion in Lower Styria in 1842," by the same. (This paper will be published in these Annals and in the Society's Transactions.)

A letter from Dr. Bidwell was read, announcing the discovery of *Vaccinium macrocarpum* near Mold in Flintshire in August last; and one from Mr. W. A. Stables noticing the discovery of *Neottia nidus-avis* in Cawdor Woods, Nairnshire.

Dr. Balfour exhibited specimens of diseases in plants caused by insects; one of these consisted of peculiar stipitate excrescences on the leaves of a North American tree, concerning which Dr. Balfour read some extracts from a letter which he had received from Mr. Adam White of the British Museum:—

"The swellings on the leaves of the plant seem to be caused by some species of *Aphis*; one kind is very hurtful to the peach-tree, but attacks the leaves in a different way from the insect on your specimen. Dr. Harris, in his admirable work 'On the insects of Massachusetts injurious to vegetation,' speaks of some *Aphides*, 'the punctures of which affect plants in a most singular manner, producing warts or swellings, which are sometimes solid and sometimes hollow, and contain in their interior a swarm of lice, the descendants of a single individual, whose punctures were the original cause of the tumour. I have seen reddish tumours of this kind as big as a pigeon's egg growing upon leaves, to which they were attached by a slender neck, and containing thousands of small lice in their interior.' Possibly the excrescences may be caused by some minute moth (Tortricidous or Tineidous), as there are evidences of some little larva that has eaten away the parts between the cuticle at the base of some of the excrescences. Your specimens I have examined, but do not find any fragments of the insects, although there are traces of dung and a small part of a web, certainly remains of a moth; and there is no reason why the excrescences may not be the nidi for the eggs of an *Eriosoma* (an aphididous insect), and the web, dung, and eaten part, evidences of some *Tinea*. Mr. Doubleday has observed similar warts on leaves, but knows not how they are produced."